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(54) Toilet paper and process for producing the same

Toilettenpapier und Verfahren zu seiner Herstellung

Papier de toilette et procédé pour sa fabrication

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## Description

This invention relates to a toilet paper suitable for use on toilets equipped with a washing facility. The invention also relates to a process for producing such a toilet paper.

Due to their convenience and obvious advantages for hygiene, toilets equipped with a washing facility are fast gaining acceptance. However, as for toilet paper, nothing has yet been developed that is adapted for use with such toilets.

In toilets of the type described above, lukewarm water is used for washing. However, conventional toilet paper is not only incapable of absorbing much water, it also tends to disintegrate upon contact therewith.

Compared to toilet paper, tissue paper which is provided with a wet strength modifier exhibits considerable strength in the presence of water but, on the other hand, it cannot be directly disposed of in flush toilets.

Although a layered toilet paper is described in US 4,012,281 the layers are bonded together by adhesive and thus the paper is not suitable for use on toilets equipped with a washing facility. The finished toilet paper of US 4,012,281, which is of single ply, is formed from two layers, the first layer being formed from short fibrous material and a second layer being formed from fibrous material and rayon. When the first and second layers are combined, binder migrates from the first layer into the second layer thereby bonding the layers together.

The present invention has been accomplished under these circumstances and has as an object the provision of a toilet paper that is sufficiently water absorbent and strong to withstand use with copious amounts of water, that is dispersible in a water flush toilet, and that also has an agreeable texture.

Another object of the present invention is to provide a process for producing said improved toilet paper.

The first object of the present invention can be attained by the invention which relates to a toilet paper that has a three-layer structure comprising an intermediate layer which has on one side thereof a top layer and the other side thereof a bottom layer. The intermediate layer comprises about 100% wood pulp and the top and bottom layers comprise wood pulp and rayon pulp as mixed in a weight ratio of about 40 - 80:60 - 20 wherein there is no bonding adhesive between the layers and wherein the paper is dispersible in water.

In one embodiment of the present invention, the three-layer structure is characterized in that the intermediate layer has a basis weight of about 15 - 25 g/m<sup>2</sup> and that the top and bottom layers have a basis weight of about 15 - 30 g/m<sup>2</sup> respectively, with the three layers being embossed as they are superposed in a unitary assembly. In another embodiment of the present invention, the three-layer structure is characterized by containing a water-soluble polymeric binder in an amount of about 0.5 - 10% in the top and/or bottom layers.

The second object of the present invention can be attained by the invention which relates to a process for producing a toilet paper having a three-layer structure, which process comprises forming an intermediate layer from a paper stock slurry of about 100% wood pulp in the usual manner, sandwiching the intermediate layer between a top and bottom layers that are formed in the usual manner from a paper stock slurry comprising wood pulp and rayon pulp as mixed in a weight ratio of about 40 - 80:60 - 20, and embossing the three layers as they are superposed in a unitary such that adhesive is not required to attach the top layer and the bottom layer to the intermediate layer and wherein the paper is dispersible in water.

The sheet of paper which serves as the intermediate layer in the three-layer structure substantially comprises wood pulp which exhibits a satisfactory ability not only to absorb water but also disperse rapidly in water. A slurry having this wood pulp dispersed therein is subjected to the usual paper making method on a conventional paper machine such as a cylinder machine, a Fourdrinier machine or a twin-wire machine. The wood pulp to be used is typified by softwood or hardwood pulp and can be prepared by either a mechanical or a chemical process. The sheet of paper under consideration advantageously has a basis weight of about 15 - 25 g/m<sup>2</sup>. If the basis weight exceeds about 25 g/m<sup>2</sup> or about 55 g/m<sup>2</sup>, the increased thickness or bulkiness will render the product toilet paper to be no longer easy to use. On the other hand, if the basis weight is less than about 15 g/m<sup>2</sup>, the ability of the sheet to absorb and retain water be insufficient. It is also within the scope of the present invention to compose the intermediate layer in the three-layer structure of a multiple ply, and a good balance between water absorption and ease of use can be attained by forming the intermediate from a sheet of paper having a basis weight of about 20 g/m<sup>2</sup> or less. In this case, it is preferred that the total basis weight of the multiple ply sheet is about 15 - 40 g/m<sup>2</sup> for the intermediate layer in the three-layer structure.

Each of the top and bottom layers in the three-layer structure is a sheet of paper comprising a mixture of wood pulp and rayon pulp. The wood pulp may be the same as that is used to prepare the intermediate layer in the three-layer structure. The rayon pulp may either comprise viscose rayon or cuprammonium rayon and it is typically used after being out to a size of less than about 10 mm with a diameter of 1 - 8 deniers, preferably 4 - 6 mm with a diameter of 1 - 2 deniers. Since the rayon pulp has hydrophilicity which is a characteristic of cellulose, it can be readily mixed with the wood pulp to prepare paper. Further, the rayon pulp has a better texture and a greater strength than the wood pulp and, hence, by mixing the two kinds of pulp, a paper can be prepared that provides a better feel and that also has a satisfactory strength in water. A particular advantage will result from using rayon pulp of a fine denier since the ability

to absorb water is improved and, at the same time, increased softness will provide a better feel.

The mixing ratio of wood pulp to rayon pulp in each of the top and bottom layers in the three-layer structure is about 40 - 80:60 - 20, preferably about 65 - 75:35 - 25; in other words, the ratio of rayon pulp must be adjusted to about 20 - 60%. The ratio of rayon pulp to be contained in the top and bottom layers in the three-layer structure is determined by four factors, i.e., water absorption, water dispersibility, touch to the skin and service strength. If the ratio of rayon pulp is unduly low, the service strength of the final product will decrease and, at the same time, its feel will deteriorate. If the ratio of rayon pulp is excessive, water absorption by the final product is impaired. In whichever case, the final product is not suitable for use in the special application contemplated by the present invention.

In each of the top and bottom layers in the three-layer structure the sheet of paper comprising a mixture of wood pulp and rayon pulp has desirably a basis weight of about 15 - 30 g/m<sup>2</sup>. The total basis weight of the toilet paper is desirably adjusted to about 45 - 85 g/m<sup>2</sup> for the three-layer structure containing the intermediate layer. If the basis weight of the toilet paper is excessive, it will become rigid enough to cause inconvenience in use. The mixing ratio of wood pulp to rayon pulp and the basis weight may be adjusted to differ in the top and bottom layers. If this is to be done, it is advantageous from an economic viewpoint to reduce the use of rayon pulp in the sheet on the side opposite the use side by mixing it in a comparatively small amount or by reducing the basis weight of that side. If desired, the toilet paper of the present invention may be used after it is folded two or more times. The use side is desirably provided by the top or surface layer and using the bottom layer on that side should be avoided.

In the present invention, the intermediate layer as sandwiched between the top and bottom layers to form a three-layer structure is embossed to provide a unitary assembly of the individual layers while creating a soft feel. To this end, a mold or roll having a multiple of elevations and/or depressions is pressed against one or both sides of the superposed structure or a pair of molds or rolls, one being male and the other being female, are pressed from both sides of the superposed structure; as a result of this treatment, an embossment is produced on at least one surface composing of the structure.

If the fibers composing the sheet serving as the top and bottom layers in the three-layer structure are not fixed securely, rayon pulp can potentially shed off as particles from the sheet although the amount of shedding fibers may be slight. This problem can be effectively avoided by adding a water-soluble polymeric binder to the top and/or bottom layers and the surface layer in an amount of about 0.5 - 10%, preferably about 1.5 - 3.0%, on the basis of the total weight of wood and rayon pulps. Exemplary water-soluble polymeric binders include poly(vinyl alcohol), carboxymethyl cellulose, poly(acrylic acid), acrylic acid copolymers, poly(methacrylic acid), methacrylic acid copolymers, polyacrylamide, acrylamide copolymers, poly(vinyl pyrrolidone), poly(vinyl ether), sulfonated polystyrene and itaconic acid copolymers. If the addition of these water-soluble polymeric binders is unduly small, their effect will not be attained; if their addition is excessive, various troubles will occur during manufacture such as the staining of the dryer used in the drying step.

The toilet paper of the present invention is capable of absorbing and retaining a large amount of water since a sheet of paper comprising about 100% wood pulp is used as the intermediate layer in the three-layer structure. On the other hand, the layer comprising about 100% wood pulp, if it absorbs a large amount of water, will experience a marked drop in strength, so during use, it will easily disintegrate. In the toilet paper of the present invention, at least one side of the intermediate layer of the three-layer structure which is to contact the private parts is covered with the top and/or bottom layers, which is a sheet of paper comprising wood and rayon pulps as mixed in the proportions of about 40 - 80:60 - 20; therefore, the intermediate layer of the three-layer structure will not make direct contact with the private parts, nor will it experience any trouble such as rupture or twist; as a further advantage, those layers are capable of retaining the initial sheet form even if they absorb a large amount of water. In contrast, the top layer of the three-layer structure which is to make direct contact with the private parts comprising a pulp mixture about 20 - 60% of which is rayon pulp and, hence, it has sufficient wet strength against water to experience neither rupture nor twist during use; in addition, the top layer provides a soft feel. Further, the top layer which contains about 40 - 80% wood pulp have a certain degree of water absorbency; hence, they absorb part of the water present, permitting the remainder to be rapidly carried for permeation into the intermediate layer which has great ability to absorb and retain water. The bottom layer in the three-layer structure will function in almost the same manner as the top layer.

As a further advantage, a sheet of paper that is prepared solely from wood pulp and which is to form the intermediate layer in the three-layer structure as well as the sheet of paper that is prepared from a mixture of wood and rayon pulps and which is to form the top and bottom layers in the three-layers structure will be composed of unbound constituent fibers and accordingly will disperse upon continued stirring in water; hence, the toilet paper of the present invention can be directly disposed of in flush toilets.

Sheets having excellent water absorbency and service strength can be produced by adjusting the basis weight of the intermediate layer to about 15 - 25 g/m<sup>2</sup> and that of the top and bottom layers to about 15 - 30 g/m<sup>2</sup>. If the three layers as they are superposed in a unitary assembly are embossed, softness of paper will be created to provide an even better feel.

If a water-soluble polymeric binder is added to the top and/or bottom layers in an amount of 0.5 - 10% of the total

pulp weight, the fixation of the rayon pulp in the sheet is secured to prevent the pulp fibers from shedding as particles.

As described above, the intermediate layer of the toilet paper of the present invention is prepared different in composition from both the top and bottom layers and, in addition, rayon pulp is contained in the top and bottom layers in the specified proportion; as a result, the toilet paper of the invention is satisfactory in all aspects of performance, i. e., water absorption, water dispersibility, feel and service strength.

The following examples are provided for the purpose of further illustrating the present invention but are in no way to be taken as limiting.

#### Example 1

A sheet having a basis weight of 20 g/m<sup>2</sup> was prepared from a slurry of 100% softwood pulp using a cylinder paper machine. The sheet was used as the intermediate layer. Sheets for use as the top and bottom layers were prepared by the following method: softwood pulp and rayon pulp (1.5 d; fiber length = 5 mm) were mixed in a weight ratio of 75:25 and, to the mixture, poly(vinyl alcohol) was added in an amount of 3% of the total pulp weight, thereby providing slurry; using the slurry, sheets having a basis weight of 20 g/m<sup>2</sup> were obtained.

The intermediate layer was sandwiched between the top and bottom layers and the respective layers, as they were placed in superposition, were embossed over the entire surface to prepare bathroom paper in which the three constituent layers formed a unitary assembly.

#### Examples 2 - 6

Five additional samples of toilet paper were prepared by repeating the procedure of Example 1 except that the mixing ratio of softwood pulp to rayon pulp in the sheet to be used as the top and bottom layers was varied as 90:10, 55:45, 45:55, 30:70 and 0:100.

To check their quality and performance, the samples of toilet paper which were prepared in Examples 1 - 6 were tested in the following manner:

(1) Ten volunteers used five specimens of each of the samples on toilet equipped with a washing facility and they performed a subjective evaluation of each sample with respect to various parameters. Each of the samples had an area of 20 cm X 23 cm and was folded in four times before it was used. The scores given by each volunteer were added up to provide an overall rating for each sample in accordance with the following criteria:

- ⊙ excellent
- good
- Δ fair
- × poor

(2) The test parameters were as follows:

Water absorbency	The ability of bathroom tissue to absorb water and moisture.
Water dispersibility	The ease with which bathroom tissue is dispersed and disposed of in a flush toilet.
Touch to the skin	The feel of the bathroom tissue.
Service strength	The ability to withstand the action of wiping off water without rupture twist.

The results are shown in Table 1 below.

Table 1.

Results of Testing for Quality and Performance						
Mixing ratio	90:10	75:25	55:45	45:55	30:70	0:100
Water absorbency	⊙	⊙	⊙	○	Δ	×
Water dispersibility	⊙	⊙	⊙	⊙	○	○
Touch to the skin	Δ	○	○	○	○	⊙
Service Strength	×	⊙	⊙	⊙	⊙	⊙
Note: "Mixing ratio" refers to that of wood pulp to rayon pulp in the top and bottom layers.						

As is clear from Table 1, when the ratio of rayon pulp in its mixture with wood pulp from which sheets were prepared for making the top and bottom layers was 10%, the toilet paper had such a low wet strength against water that it was either ruptured or twisted during use. When the ratio of rayon pulp was 25%, the service strength was satisfactory and, in addition, the feel was improved. On the other hand, when the content of wood pulp was 30% or 0%, the ability of the top and bottom layers to absorb water momentarily was insufficient to permit passage of water through those layers to reach the intermediate layer, where it would otherwise be absorbed and retained. When the ratio of wood pulp was 45%, the water absorbency was markedly improved. It can therefore be seen that only when the mixing ratio of wood pulp to rayon pulp is controlled as specified herein, toilet paper can be produced that permits the intermediate layer to exhibit its water absorbing ability to the fullest extent and which yet is improved in service strength and feel.

The toilet paper of the present invention comprises a three-layer structure in which a sheet of paper comprising about 100% wood pulp and sheets of paper comprising an about 40 - 80: 60 - 20 mixture of wood and rayon pulps are superposed in such a way that the sheet comprising the pulp mixture will form the use layer. When this toilet paper is used to wipe off a large amount of water, the sheet of paper comprising about 100% wood pulp will rapidly absorb the water since it has the great ability to absorb and retain water, whereas the sheets of paper comprising the pulp mixture which come into contact with the skin imparts a soft feel. Furthermore, not only the sheet that is solely prepared from wood pulp but also the sheets that are prepared from the pulp mixture with no more than about 60% rayon pulp have good water dispersibility and, hence, the toilet paper of the present invention can be directly disposed in flush bathrooms.

The toilet paper of the present invention can be used with greater ease if the following additional conditions are met: the basis weight of the intermediate layer and that of the top and bottom be adjusted to layers about 15 - 25 g/m<sup>2</sup> and about 15 - 30 g/m<sup>2</sup>, respectively; a small amount of a water-soluble polymeric binder be added to the top and/or bottom layers, and the three layers placed in superposition be embossed in a unitary assembly.

The toilet paper of the present invention is best suited for use on toilet equipped with a washing facility. It should, be noted, however, that said toilet paper can also be used advantageously in conventional toilets and that it can be sold on the market in various forms such as rolls of a suitable size or portable sheets that are cut to convenient lengths.

#### Claims

1. A toilet paper comprising an intermediate layer having on one side thereof a top layer and on the other side thereof a bottom layer, said intermediate layer comprising about 100% wood pulp and said top and bottom layers comprising wood pulp and rayon pulp as mixed in a weight ration of about 40 - 80:60 - 20 wherein there is no bonding adhesive between the layers and wherein the paper is dispersible in water.
2. A toilet paper according to claim 1 wherein said intermediate layer has a basis weight of about 15 - 25 g/m<sup>2</sup> and said top and bottom layers have a basis weight of about 15 - 30 g/m<sup>2</sup>, respectively.
3. A toilet paper according to claim 1 or Claim 2 wherein the three layers are embossed as they are superposed in a unitary assembly.
4. A toilet paper according to any one of claims 1 to 3 wherein a water-soluble polymeric binder is added to said top and bottom layers in an amount of about 0.5 - 10% of the total weight of the wood and rayon pulps.
5. A process for producing a toilet paper which comprises forming an intermediate layer from a paper stock slurry of about 100% wood pulp in the usual manner, sandwiching said intermediate layer between a top and bottom layers which are formed in the usual manner from a paper stock slurry comprising wood and rayon pulps as mixed in weight ratios of about 40 - 80:60 - 20, and embossing the three layers as they are superposed in a unitary assembly such that adhesive is not required to attach the top layer and the bottom layer to the intermediate layer and wherein the paper is dispersible in water.

#### Patentansprüche

1. Toilettenpapier mit einer Zwischenschicht mit einer oberen Schicht auf ihrer einen Seite und einer unteren Schicht auf ihrer anderen Seite, wobei die Zwischenschicht etwa 100 % Holzzellstoff und die oberen und unteren Schichten ein Holzzellstoff/Kunstseidepulpe-Gemisch im Gewichtsverhältnis von etwa 40-80/60-20 umfassen, zwischen den Schichten kein bindender Klebstoff vorhanden ist und das Papier in Wasser dispergierbar ist.

2. Toilettenpapier nach Anspruch 1, wobei die Zwischenschicht ein Grundgewicht von etwa 15-25 g/m<sup>2</sup> und die oberen und unteren Schichten jeweils ein Grundgewicht von etwa 15-30 g/m<sup>2</sup> aufweisen.
3. Toilettenpapier nach Anspruch 1 oder 2, wobei die drei Schichten übereinandergelegt als einheitliches Gebilde geprägt werden.
4. Toilettenpapier nach einem der Ansprüche 1 bis 3, wobei den oberen und unteren Schichten ein wasserlösliches polymeres Bindemittel in einer Menge von etwa 0,5-10 % des Gesamtgewichts von Holzzellstoff und Kunstseidepulpe zugesetzt ist.
5. Verfahren zur Herstellung eines Toilettenpapiers durch Ausbilden einer Zwischenschicht aus einem Papier(vorrats)brei von etwa 100 % Holzzellstoff in üblicher bekannter Weise, Einfügen der Zwischenschicht zwischen in üblicher bekannter Weise aus einem Papier(vorrats)brei mit einem Gemisch aus Holzzellstoff und Kunstseidepulpe im Gewichtsverhältnis von etwa 40-80/60-20 gebildete obere und untere Schichten und Prägen der drei übereinanderliegenden Schichten als einheitliches Gebilde dergestalt, daß zur Befestigung der oberen und unteren Schicht an der Zwischenschicht kein Klebstoff benötigt wird und wobei das Papier in Wasser dispergierbar ist.

#### Revendications

1. Papier toilette comprenant une couche intermédiaire présentant sur l'une de ses faces une couche supérieure et sur l'autre face une couche inférieure, ladite couche intermédiaire comprenant environ 100% de cellulose technique et lesdites couches supérieure et inférieure comprenant de la cellulose technique et de la rayonne technique mélangées dans un rapport pondéral d'environ 40-80:60-20 dans lequel il n'existe aucun adhésif de liaison entre les couches et dans lequel le papier est dispersable dans l'eau.
2. Papier toilette selon la revendication 1 dans lequel ladite couche intermédiaire a un grammage d'environ 15-25 g/m<sup>2</sup> et lesdites couches supérieure et inférieure ont un grammage d'environ 15-30 g/m<sup>2</sup>, respectivement.
3. Papier toilette selon la revendication 1 ou la revendication 2, dans lequel les trois couches sont gaufrées au moment de leur superposition sous forme d'assemblage unitaire.
4. Papier toilette selon l'une quelconque des revendications 1 à 3, dans lequel un liant polymérique hydrosoluble est ajouté auxdites couches supérieure et inférieure à raison d'environ 0,5-10% du poids total des cellulose et rayonne techniques.
5. Procédé pour la production d'un papier toilette comprenant les étapes consistant à former de façon conventionnelle une couche intermédiaire à partir d'une suspension de papier raffiné constitué d'environ 100% de cellulose technique, intercaler ladite couche intermédiaire entre une couche supérieure et une couche inférieure formées de façon conventionnelle à partir d'une suspension de papier raffiné comprenant de la cellulose et de la rayonne techniques mélangées dans un rapport pondéral d'environ 40-80:60-20, et gaufrer les trois couches au moment de leur superposition sous forme d'un assemblage unitaire de telle sorte qu'un adhésif n'est pas nécessaire pour fixer la couche supérieure et la couche inférieure à ladite couche intermédiaire et dans lequel le papier est dispersable dans l'eau.